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DIGEST OF D. I. BLOKHINTSEV'S "PASSAGE OF NUCLEONS THROUGH MATTER"

This article discusses the retardation of nucleons, taking into account the proton-neutron "inter-charge." Formulas and curves are found for the angular distribution of the effective cross section of elastic scattering in the nuclear reaction (p,n). Similarly found are the nuclear and ionization paths versus energy (up to 18 Mev). The function determining "inter-charge" is found for the transitions: p to n and n to p.

The effective cross section for the collision of two nucleons in a relative coordinate system is considered. It involves: the matrical element of the energy V of interaction between the two nucleons, relative momentum p_0 before collision, momentum p after, relative velocity v_0, and the element of the solid angle of scattering.

The energy V of interaction is considered. It assumes a form like that of Yukawa's formula for the meson, namely, the meson potential. This energy expression also contains the exchange operator P for the charge of the proton and neutron, and the amplitudes a,b of ordinary and exchange interaction. For the collisions (p,p) and (n,n), the exchange amplitude, or coefficient, b equals zero.

Next is obtained the differential cross section, by combination of the two above formulas, in terms of the energy E of the primary nucleon in the laboratory system of coordinates (the second nucleon is considered at rest) and the energy loss e of the primary nucleon.

This differential cross section is integrated with respect to energy loss e from 0 to E to obtain the total cross section.

The data of Hadley, Kelly, et al. (*Physical Review*, 75, 351, 1949), on the angular distribution during (n,p) scattering for energies of 40 to 90

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Mev indicate a symmetrical cross section, i.e., we are forced to take a and b equal to one. In this way the value of a certain lumped term occurring throughout the cross-section formula is found to be equal to 20 Mev, i.e., $h^2k^2/2m$ equals 20 Mev, where m is the nucleon mass and k is from Yukawa's meson formula and equal to 10^{13} centimeters.

Thus, a curve can be drawn for cross section versus scattering angle in the case of elastic (p,n) scattering (a=b=1), which fits Hadley's data. If, in our formula for cross section we take a equal to one and b equal to 0 (as in the collision of p,p and n,n), our cross section agrees with the data of Cook, McMillan, et al. (Physical Review, 72, 1,264, 1947).

The rest of the article takes up the following:

The total cross section, as a function of Energy E, found by integrating the differential element of the cross-sectional function of the energy loss e from E/2 to $E-E_f$ where E_f is the limiting energy of Fermi distribution.

The inverse of the above total cross section times the number N of nucleons, giving the so-called exchange length L(E), which is graphed, and also the total free path of neutrons R(E).

Finally, the formulas P(E,x)dE and N(E,x)dE are discussed. These express the number of protons and neutrons, respectively, of energy between E and E+dE penetrating to a depth x in matter. These important formulas involve the delta-function, free path, and an exponential psi-function.

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